CLAIMS

What is being claimed is:

1. A semiconductor light emitting device comprising:

a nucleation region; and

an epitaxial structure comprising:

a base region formed on the nucleation region; and

a III-nitride light emitting layer overlying the base region and disposed between an n-type region and a p-type region and overlying the base region; wherein:

the light emitting layer is configured to emit light having a peak emission wavelength greater than 420 nm; and

the light emitting layer and base region are configured such that:

the light emitting layer has an average InN composition b; and

an InN composition at any point in the light emitting layer is between (b – 0.2b) and (b + 0.2b).

2. The device of claim 1 wherein the InN composition at any point in the light emitting layer is between (b – 0.1b) and (b + 0.1b).

3. The device of claim 1 wherein InN composition at any point in the light emitting layer is between (b – 0.05b) and (b + 0.05b).

4. The device of claim 1 wherein the light emitting layer is InGaN.

5. The device of claim 1 wherein:

the base region has a lattice constant a_1;

a relaxed, free standing layer having a same composition as the light emitting layer has a lattice constant a_2; and

a ratio of a_2 to a_1 is between about 1 and about 1.01.

6. The device of claim 1 wherein the base region is $Al_xIn_yGa_zN$, where $0 \leq x \leq 1$, $0 \leq y \leq 1$, and $0 \leq z \leq 1$.

7. The device of claim 1 wherein the base region is In_xGa_yN, where $0 \leq x \leq 1$ and $0 \leq y \leq 1$.

8. The device of claim 1 wherein a dislocation density in the n-type region, light emitting layer, and p-type region is less than about 5×10^8 cm^{-2}.

9. The device of claim 1 wherein the light emitting layer and any layers between the light emitting layer and the base region are strained.

10. A semiconductor light emitting device comprising:

a nucleation region; and

an epitaxial structure comprising:

a base region formed on the nucleation region; and

a III-nitride light emitting layer overlying the base region and disposed between an n-type region and a p-type region; wherein the light emitting layer and base region are configured such that:

the light emitting layer has an average InN composition b;

the average InN composition b is greater than 8%; and

an InN composition at any point in the light emitting layer is between (b – 0.2b) and (b + 0.2b).

11. The device of claim 10 wherein the InN composition at any point in the light emitting layer is between (b – 0.1b) and (b + 0.1b).

12. The device of claim 10 wherein InN composition at any point in the light emitting layer is between (b – 0.05b) and (b + 0.05b).

13. The device of claim 10 wherein the light emitting layer is AlInGaN.

14. The device of claim 10 wherein:

the base region has a lattice constant a_1;

a relaxed, free standing layer having a same composition as the light emitting layer has a lattice constant a_2; and

a ratio of a_2 to a_1 is between about 1 and about 1.01.

15. The device of claim 10 wherein the base region is $Al_xIn_yGa_zN$, where $0 \leq x \leq 1$, $0 \leq y \leq 1$, and $0 \leq z \leq 1$.

16. The device of claim 10 wherein the light emitting layer is configured to emit light having a peak emission wavelength greater than 420 nm.

17. A III-nitride light emitting device comprising:

a nucleation region;

a base region formed on the nucleation region, the base region having a lattice constant a_1; and

a light emitting layer overlying the base region and disposed between an n-type region and a p-type region; wherein:

the light emitting layer has an average InN composition greater than 8%;

a relaxed, free standing layer having a same composition as the light emitting layer has a lattice constant a_2; and

a ratio of a_2 to a_1 is between about 1 and about 1.01.

18. The device of claim 17 wherein the light emitting layer is configured to emit light having a peak emission wavelength greater than 420 nm.

19. The device of claim 17 wherein the base region is $Al_xIn_yGa_zN$, where $0 \leq x \leq 1$, $0 \leq y \leq 1$, and $0 \leq z \leq 1$.

20. The device of claim 17 wherein the base region is In_xGa_yN, where $0 \leq x \leq 1$ and $0 \leq y \leq 1$.

21. The device of claim 17 wherein a dislocation density in the base region, n-type region, light emitting layer, and p-type region is less than about $5x10^8$ cm^{-2}.

22. The device of claim 17 wherein:

the light emitting layer is In_xGa_yN where $0.08 \leq x \leq 1$; and

the base region is In_aGa_bN where $(x-0.08) \leq a \leq 1$.

23. The device of claim 17 further comprising:

a first contact electrically connected to the n-type region;

a second contact electrically connected to the p-type region;

a lead frame electrically connected to the first and second contacts; and

a cover overlying the light emitting layer.

24. The device of claim 17 wherein the light emitting layer has a thickness greater than 5 nm.

25. The device of claim 17 wherein the light emitting layer has a thickness greater than 10 nm.

26. The device of claim 17 wherein the light emitting layer is a first quantum well, the device further comprising:

a second quantum well; and

a barrier layer disposed between the first and second quantum well.

27. The device of claim 17 wherein the light emitting layer and any layers between the light emitting layer and the base region are strained.

28. The device of claim 17 wherein the base region is the n-type region.

29. A III-nitride light emitting device comprising:

a substrate;

a base region formed on the substrate, the base region having a lattice constant a_1; and

a light emitting layer overlying the base region and disposed between an n-type region and a p-type region; wherein:

the light emitting layer has an average InN composition greater than 8%;

a relaxed, free standing layer having a same composition as the light emitting layer has a lattice constant a_2; and

a ratio of a_2 to a_1 is between about 1 and about 1.01.

30. The device of claim 29 wherein the light emitting layer is configured to emit light having a peak emission wavelength greater than 420 nm.

31. The device of claim 29 wherein the base region is $Al_xIn_yGa_zN$, where $0 \leq x \leq 1$, $0 \leq y \leq 1$, and $0 \leq z \leq 1$.

32. The device of claim 29 wherein the base region is In_xGa_yN, where $0 \leq x \leq 1$ and $0 \leq y \leq 1$.

33. The device of claim 29 wherein:

the light emitting layer is In_xGa_yN where $0.08 \leq x \leq 1$; and

the base region is In_aGa_bN where $(x-0.08) \leq a \leq 1$.

34. The device of claim 29 wherein the substrate is SiC.

35. A method comprising:

growing an epitaxial stack on a growth substrate, the epitaxial stack comprising:

a base region having a lattice constant a_1; and

a light emitting layer overlying the base region and disposed between an n-type region and a p-type region;

bonding the epitaxial stack to a host substrate; and

removing the growth substrate; wherein:

the light emitting layer has an average InN composition greater than 8%;

a relaxed, free standing layer having a same composition as the light emitting layer has a lattice constant a_2; and

a ratio of a_2 to a_1 is between about 1 and about 1.01.

36. The method of claim 35 wherein the light emitting layer is configured to emit light having a peak emission wavelength greater than 420 nm.

37. The method of claim 35 wherein the base region is $Al_xIn_yGa_zN$, where $0 \leq x \leq 1$, $0 \leq y \leq 1$, and $0 \leq z \leq 1$.

38. The method of claim 35 wherein the base region is In_xGa_yN, where $0 \leq x \leq 1$ and $0 \leq y \leq 1$.

39. The method of claim 35 wherein:

the light emitting layer is In_xGa_yN where $0.08 \leq x \leq 1$; and

the base region is In_aGa_bN where $(x\text{-}0.08) \leq a \leq 1$.